Materials Engineering Branch

TIP*

No. 078 Inspection of Bearings and Lubricated Components for Non-wetting

Author(s): Carl L. Haehner Contact: (301) 286-6882

Precision instrument bearings are extremely sensitive to contamination, both molecular and particulate. Two examples of how contamination can be introduced are described followed by a method for inspecting bearings for contamination. The examples chosen are two of the less obvious ones that can be easily overlooked.

Example 1: Given an approved anti-static bagging material, the average user generally makes little or no distinction regarding the application, which may cause him to misuse an otherwise perfectly acceptable material. For example, current materials used for packaging spacecraft instruments and bearings contain minor amounts of anti-static agents that are potential contaminants to bearings, especially when the two come in direct contact with one another. If the user is not aware of this, he can easily contaminate a lubricated component that has, to that point, been treated with the utmost care.

Example 2: In a recent experiment, bearings were treated with tricresyl phosphate (TCP) to enhance the lubrication properties of the hydrocarbon oil, a perfectly acceptable and sometimes recommended procedure. However, when the choice of lubricant was changed to fluorinated oil, at some later date, the TCP treatment was not deleted from the associated lubrication process. As the fluorinated oil and TCP are immiscible, when the two were used together it resulted in a contamination problem. Regardless of the source, such contamination of surfaces can cause non-wetting (of the affected surfaces) by the lubricant. Non-wettability is a precursor of lubricant starvation in a bearing and leads to premature bearing failure.

Normally, wettability of a fluid is determined by contact angle measurements, where the contact angle is formed by a line tangent to the outside surface of the fluid and the line of the surface (see Figure 1). As the angles on a clean surface are low (less than 20°), a visual inspection of a lubricated system will readily show wettability. Lubricated surfaces which show widely dispersed beads of lubricant are contaminated and a reprocessing of the component is required. On normal bearing surfaces that

have been properly prepared and stored without being contaminated, fluid lubricants should spread spontaneously forming a continuous layer with a contact angle of close to zero. With small components it may be necessary to use a low power microscope.

All bearings and other lubricated components should be inspected for wettability after lubrication and before assembly into the system.

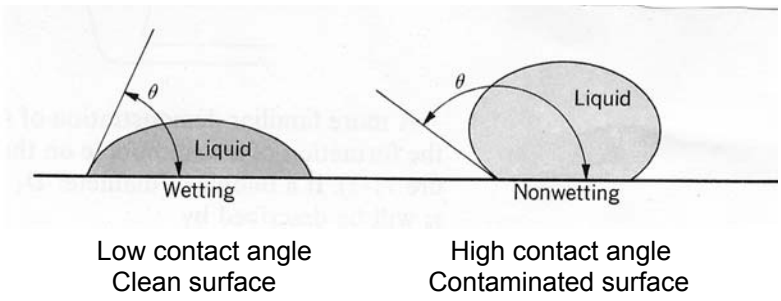

Figure 1. Illustration of contact angle as a function of surface cleanliness.